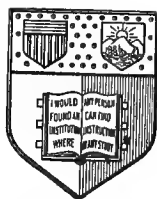


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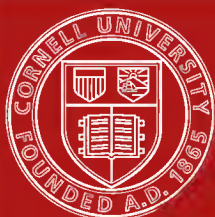
BENEFITS OF
DRAINAGE
AND HOW TO DRAIN.



New York State Drain Tile
AND
Fireproofing Works

JOHN H. JACKSON,

ALBANY, N. Y.



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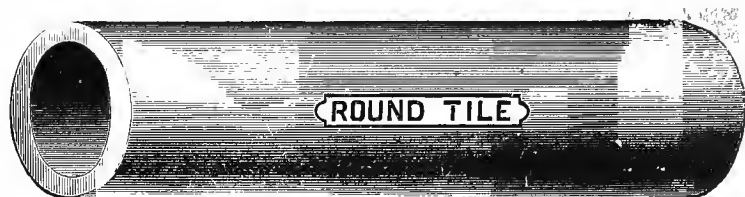
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ESTABLISHED IN 1852

JOHN H. JACKSON,

Successor to JACKSON BROS.



New York State Drain Tile

AND

Fireproofing Works

Works and Main Office, Third Avenue,

ALBANY, N. Y.

Weed-Parsons Printing Company, Albany N. Y.

DRAINAGE.

In almost every State in the Union there are to-day thousands of acres of valuable land, lands that with ordinary cultivation are yielding immense crops, where but a few years since were swamps and bogs.

Nature has been good to man. It has given him a great abundance of raw materials with which to work; in the great varieties of soils and their indigenous growths she presents us an open book, which, if we will but study it, will teach us how to make her to us at first "waste places" to blossom as a garden. But nature gives us few perfect things ready made, and entirely fit for use. She requires us to work, to work with mind and muscle, and with strict justice she pays us for the work. The farmer who owns a swamp or bog, well knows that it, while it remains a swamp or bog, will yield no profitable crop; he knows that into this low spot the rains of countless ages have floated much of the decayed and decaying vegetation of the surrounding higher land, and that it has been as continuously, and to a much greater extent, enriched by the decay of its own rank growth, until the loam has become deep and strong, capable of bearing grand crops—if, only, it were not so wet and cold. All such places may be drained; as remarked in our opening lines, thousands of acres have been so improved, always with paying results, and millions of other acres are awaiting improvement. Only within a comparatively few years have farmers begun to bestow upon this subject any considerable attention, and it still receives far less general consideration than it deserves. Yet the value of good drainage is becoming better known and more appreciated.

Agriculture is the undisputed basis of all prosperity and wealth; it is the support and foundation for all other kinds of business, and yet has the least protection of any in this respect. What matters it to the manufacturer whether it be cold or warm,

wet or dry; he is protected himself with staunch buildings, and his business goes on without interruption, delay, or uncertainty in yield or profit. The farmer can also as certainly and easily protect his business from either extreme, wet or drought, and he can make his soil warmer; his crop growing season longer; he can arrange to work his ground quicker after rains, and get ahead of the weeds, instead of weeds getting ahead of him, thereby keeping his growing crop clean easier and with less labor, which means cheaper — that is, larger profits.

How? Simply by tiling his land thoroughly — that is, laying a network of tile — not an isolated line of tile in this depression and the next — for “thorough drainage” is absolutely necessary to obtain the full benefit of this great improvement. Its advantages are so numerous and conceded, that it is astonishing why many doubting stand or still delay to at once adopt it. Lands that need draining show the hailing signs of distress, it may be in a broad sheet of water standing upon the surface, or a slough, or in low, cold, wet spots in the field, or cold high spots, or the sign of distress may be seen in the stunted growth and yellow leaves of the growing crop.

All soils that are not readily freed from excessive moisture, where the spaces between the particles of soil are full of water for any considerable length of time after rainfall, or full from spring water, need drainage. All clay soils with no underlying strata of sand or gravel sufficiently near the surface to receive down through the soil to carry away the excess of water, need drainage, whether the surface be level or rolling. Low level lands need it to rid them of surplus water, and rolling lands need it to protect them against the surface wash, and that they may be enriched by the fertilizing elements brought to the earth by the rainfalls.

The fact is that where the water does not readily pass down through the soil, it is proof positive that beneath, at some depth, is a tight bottom holding the water.

We have frequently heavy rainfall — floods of rain. If the soil remains saturated with water for any considerable length of time, the growing crops under water perish, or the leaves become yellow if the plants live. By sufficient under drainage the water passes quickly down through the soil to the drains below, the soil retaining only the necessary amount of water, no more and no less. Then we may assign as one important reason why we

should drain *that we may retain in the soil only the necessary moisture* for plant growth.

Necessity of Drainage.

There may be some very porous, sandy locations where drainage would be an unnecessary waste of labor; but such locations must form the exception to the general rule that, all farm lands require drainage for cultivating grain as well as fruit. We imagine that even to this assertion, some one may object, and instance some rolling farm or field of the common clay soils in which drainage would be practically of no benefit to the growing crops. To such we will say, we know of no such situation. Where there is a slope there must be some place for such incline to end, and there water must accumulate in wet weather, and the judicious cultivator will provide for the best means of disposing of such surplus amount of water, and if he does not, the result is always a loss to him in some way. It may be that the accumulation may "drown out" the crop whatever it may be, and thus cause the entire loss of it on the richest soil on the farm. It may be, however, that this accumulation may "wash" away this most valuable soil and carry it where it is worse than lost, for, in addition to leaving in its place a sterile spot, it adds obstruction to the stream in which it enters.

This accumulation of water on the surface at the foot of a slope can in most cases be measurably dispensed with, and in a large share of them entirely prevented.

The idea is prevalent that those long, rolling slopes do not need drainage. It is true that such lands do not so imperatively demand under draining; but in this utilitarian age we cannot afford to stay out of the field a day on account of the land being too wet when by any reasonable outlay that day might have been profitably employed in cultivating or harvesting the crop.

Heat Necessary to Plant Life

is an important factor in the growth of our crops. We often speak of cold and warm soils. The soil which is saturated with water, and from the surface of which the water is being removed by evaporation, we say of it "it is a cold soil," for evaporation is a cooling process; or if the soil be open and porous, the water passing readily down, leaving the soil free to absorb the heat of the sun, such we designate "warm soils." The storing of heat

necessary to plant growth depends upon the soil being open and porous, and clay soils can be made so only by sufficient drainage, for the reason that heat cannot pass down through water. If the soil is full of water the sun cannot warm it. If the soil be drained the heat absorbed increases the temperature from eight to fifteen degrees (F.) Corn will germinate at fifty-five degrees, at forty-five it will rot in the ground. It is not surprising, then, that of cold, wet springs, corn fails to vegetate or "come up" as we frequently express it. The increased temperature not only promotes the germination but growth of our crops. The planting or sowing may be done ten or fifteen days earlier.

A drained soil becomes a great laboratory in which is prepared the necessary supply of food for the growing crop down as deep as the tile are laid. The water passing down through the spaces between the particles of soil and through the pores of the drain below, is followed by the air freighted with fertilizing elements which are absorbed by the soil, forming other combinations with the elements of the soil, and in this way prepare an inexhaustible supply of plant food in nature's great storehouse. The roots of the plants then find their way down through the same spaces, crevices and pores through which the water found its way, and take up the needed supply of food, selecting such as is suited to its growth and well being.

Benefits of Underdrainage.

It prevents any possible damage from flooding or excessive rains. It enables the farmer to work the soil earlier in the spring and sooner after rains. It prevents the souring of the soil caused by excessive moisture. It lessens the risk of freezing out in winter grain. It lessens the risk of surface washing. It keeps the ground moist and the crops growing in a dry season. It makes the ground warmer. It permits a more thorough pulverization of the soil. It increases the fertility of the soil. It facilitates the hauling of loads over the field, and renders land less liable to injury from the treading of cattle. It facilitates the destruction of weeds, because the soil, becoming more friable, does not cling in a mass to their roots when torn up in cultivation, and the soil is worked easier as well as far more thoroughly with less effort. It removes all malaria. It reduces farming from a business of uncertain and meagre profit to one of absolute certain and lucrative profit.

To read this list of advantages may at first make one think of the advertisements of some patent medicines which are warranted to cure all and the most dissimilar complaints, but there is not one of the above points, but what has been demonstrated practically, and can be explained scientifically.

The "freezing out" of winter grain is not occasioned by the excessive cold, but by the formation of ice in the upper part of the soil, which throws out the plant and leaves it to perish. If the soil is underdrained the water passes off through the drains instead of remaining in the surface soil, and this injury is avoided.

If the soil is full of water, that which falls upon it in rain must flow off over the surface carrying with it much of the best and finest of the soil, and often doing much damage. Underdrainage leaves the pores of the soil empty, so that the water falling upon it sinks directly in, to be ultimately carried off by the drains. As an illustration of this may be noted that even steep hill sides where the subsoil is gravel, which forms a natural underdrainage, do not wash at all, while comparatively level fields in sections resting on tough clay or hard pan are continually being gullied out by surface water.

All these points are reasonably clear, but we now come to a claim that at first seems paradoxical: How can draining land keep it moist and the crops growing in a dry season?

First. By enabling the farmer to thoroughly pulverize the soil which fits the soil for drawing up moisture from below.

Second. By preventing the soil from becoming baked and cloddy. When a soil is saturated with water and becomes dry simply by evaporation, it hardens and bakes so that it is incapable of receiving moisture either from the air above or the earth below.

Third. By causing the plants to send their roots deeper into the soil. When a plant begins to grow in the spring in an undrained soil, the roots will not penetrate into the cold lower soil, filled with stagnant water, but run along through the few inches of drier surface. When the dry weather comes the sun completely dries this out, and the plant having no other source of supply, perishes. On land that has been underdrained, in the condition described as most favorable for plant growth; moist but with no standing water between the particles, the plant sends its roots far and deep. When the sun of summer dries the ground, the plant has communication with the cool moist soil far below.

The past season has demonstrated the truth of this claim

beyond a question. The best crops were grown on the well-drained fields.

Everybody knows that if a jug of water is wrapped up in a wet flannel, the water in the jug will not get warm as long as the flannel is kept soaked with water. Just so with the soil. It will not get warm as long as the surface is full of water.

Experiment has demonstrated the truth of the theory in this matter. One experimenter made a number of tests in two adjoining fields, one drained, the other undrained. The average temperature of the soil in the field that had been drained was six and a half degrees higher than in the other. Further experiments have fully confirmed these.

And this adds another to the reasons why drainage enables the earlier cultivation of a field and lengthens the season; the ground becomes warmer so much earlier in the spring and remains warm later in the fall. Drainage increases the fertility of the soil in exactly the same way as pulverizing does — by enabling the soil to absorb fertility from the atmosphere.

Drainage marks the line between swamp and grain-field; between swale and grassy meadows; between mosquito plantations and pleasant orchards and groves; between unprofitable and profitable agriculture. When such truths have been demonstrated beyond cavil by the experience of all who have tried "thorough drainage," no room is left for doubt or argument in opposition. Finally, when we reflect that land thoroughly tiled will every year produce a far heavier and cheaper cultivated crop than will untiled land under the most favorable season that may happen, why delay to adopt it?

Experience has shown that 25 to 100 per cent. profit is realized in judicious expenditure for tiling, and that the increased profit for the season will repay the entire cost of thoroughly tiling a tract of land, thereafter a permanent investment (to that amount). What investment is more lucrative than that for the farmer? It is better than banking.

Hints on Tile Drainage; or, How to Drain.

In laying out a system of underdrains, we have to consider (1) the outlet, (2) the fall, and (3) the area to be drained. To secure a good outlet is often a difficult matter, but it is useless to proceed further until this is done, as a defective one will inevitably cause the obstruction of the drains, and thus the loss of all the labor

that may have been spent upon them. While it is always better that the mouth of the drains should be entirely above the water-level of the outlet, in high water this is not absolutely essential if the latter have a good current; but it is necessary that the drain-mouth should be entirely above the low-water line of the outlet, else it will be clogged by the deposition of silt, etc., at times when the drain itself is carrying no water.

The area to be drained has an important bearing in calculating the size of tile to be used; and as the first drains laid are the ones which will serve as mains when the work is extended, especial care should be had to make them sufficiently large for all demands likely to be put upon them. The area drained by a single line of tile varies with the contour of the surface and the composition of the soil. In a narrow valley, a slough, and in a porous soil, this area will be very much wider than upon a piece of flat retentive clay. The fall of the drain also affects the quantity of water delivered. Of two pipes of equal size, one having a grade of six inches per hundred feet will carry one-third more water than one having but half that grade.

The making of one good underdrain is sure to be followed by more, as it brings out the advantage of underdrainage so sharply that portions which were before thought comparatively dry are found to be quite the opposite, and hence the drains first made should be sufficiently large to serve as mains for the whole area within their reach, the laterals to be added from time to time.

The best time for underdraining is when the soil is so saturated with water that a very small stream will constantly run in the bottom of the ditch. This stream is a better index for grading than any level, while the soil, when in condition to furnish such a stream, is also in the condition to work most easily. If the water be in excess, however, it is a disadvantage; hence the dryer weather of the summer and early fall should be improved in the drainage of ponds, swales, etc., and the work on higher portions of the farm should be done during the interval between the departure of frost and plowing time in the early spring, the tile having been brought on the ground during the fall or winter.

In digging the drains, wherever it is practicable, the plow should be the first implement used, two furrows being thrown from each other in the line of the proposed drain, and the bottom loosened and thrown out in the same manner. Of course, where practicable, the drain should be straight, but a good plowman

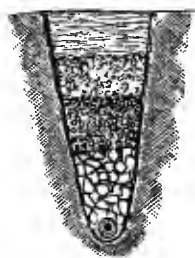
will draw his furrows so straight that the line will scarcely be needed afterward. When as much earth has been removed as possible with the plow and ordinary long-handled shovel, the line should be stretched, unless the furrows have been well made, and a spading removed with the ditching spade, which differs from an ordinary spade in having a longer and narrower blade, being about eighteen inches long and six inches wide, and curving forward like the section of a cylinder. This spading, if there be no picking to follow, should not be more than ten or twelve inches wide. The great fault of most ditchers, when working by the month or day, is that they will make the ditch too wide. If the pick has to be used, of course there must be room for the swing of the arms; but an experienced ditcher, where only spading is required, will work in a ditch so narrow that he cannot turn his hips in it, rightly arguing that it is a useless waste of labor to throw out dirt only for the pleasure of throwing it back again.

This spading being removed, it is followed by another with the tiling spade, which differs from the one just described in being narrower and tapering from the heel to the point, being there no wider than the outside diameter of the tile to be used. This spade, of course, is chiefly serviceable in the lateral drains, where 2, 2½ or 3 in. are generally used, as it is usually made but three or five inches wide at the point. If the surface be irregular, great care must now be used to preserve the grade, either by water, or, in the absence of that, by the careful use of the level. In ordinary ditching, however, the surface is so nearly uniform that little difficulty need be experienced. This spading should make the ditch from two and a half to three and a half feet deep, when in ordinary cases, it will be ready to finish by grading with the cleaner and shovel, and if water in proper quantity be present, it enables the workman to prepare the grade rapidly and perfectly for the reception of the tile.

If the fall be slight, it will be better to open the drain in considerable lengths before laying any tile, as small irregularities are liable to be left in the grading which will impair the value of the drain. But if there be considerable fall, or if the soil be of such a nature as to cave in readily, and especially if a storm be apprehended, the tile-laying should closely follow the last spading, laying the tile always from the mouth of the drain upward, and being careful never to leave it over night without stopping the upper end, so as to prevent the washing in of earth by an unex-

pected shower. In laying out a piece of drain always put them on the line of greatest slope. This is seen easily by going over the surface and marking the wettest places, or if it cannot be ascertained in this way, a common level will soon indicate the places.

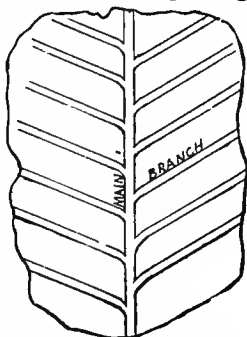
Lay the tiles so they will fit as closely at the joints as possible. If small stone and coarse gravel can be obtained, cover the tile with about six inches of the stones and about six inches of gravel on top of the stones, and then fill balance of ditch with earth (see cut).



When it is not convenient to get both stone and gravel, use about eight inches of either. When neither stone nor gravel can be obtained, cover tile at joints with refuse straw or marsh hay; or strips of common muslin about three inches wide will answer the purpose nicely; strips of tough paper have been found to work well. This prevents sand and dirt from washing into the tile at the joints until the earth becomes settled about same.

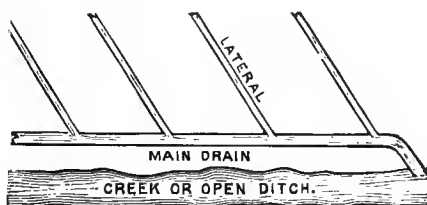
Whether collars are used or not, it is advisable to cover the tile as described above.

The sketch herewith represents the usual plan of placing the main and lateral drains. It, of course, is frequently the case that the main drain must take a very irregular course, and the lateral drains be unevenly divided and of different lengths and sizes of tile. The main drains are usually made of 4 in. or larger sizes, according to length and fall of drain, and number of laterals emptying into it. The lateral drains are, of course, made of the smaller sizes.



When there is large creek or open ditch, instead of having a large number of lateral drains empty into it thereby making any number of outlets to look after, it is frequently considered advisable to have main drain placed from fifteen to twenty feet from side of creek, and continue along the side to some point where it is thought advisable to have it empty into the creek,

(see cut). With this plan you have only one outlet, and, as it is of much larger size than the laterals, is not near so liable to get filled up in time of freshet.



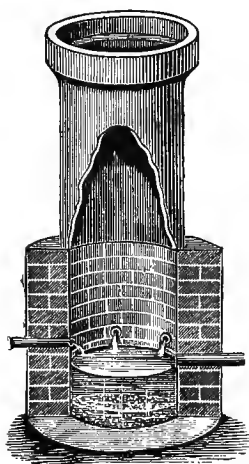
If you are lacking in knowledge or experience in this kind of work, better secure the services of one or more competent men to assist you. It will be money saved. I have a large number of competent men, practical drainers, who have had many years of experience in laying my tile, and have done many large and difficult jobs. Estimates and contracts made for draining Parks, Country places and Farms, either at so much per rod or by day's work, guaranteeing every satisfaction. When desired, I shall be pleased to send a competent man any distance to look over place and give information as to where drains should be placed, sizes and quantity of tile required and cost of doing the work.

In back part of pamphlet will be found a few of many letters referring to the work done by my drainers with my tile.

When Round Tile are used, and there is ordinary hard bottom to ditch, it is advisable to use a cleaner, for making groove along bottom of ditch, in which to lay the tile; they will then lay firmly without collars, with no liability of being displaced, as might be the case, if laid on flat bottom and filled about with loose earth.

The laterals should always enter the main at an angle less than ninety degrees, and if possible at about forty-five degrees. In this way the water from them will not retard that in the main drain. It is best if possible to have the main a little lower than the laterals, so that when they enter the main they can drop suddenly, so if the main is more than full the water will not settle back in the laterals, for if it does it forms water channels and allows silt to enter.

Silt Basins.



Silt basins or wells opening from the surface of the ground into the bottom of the tile are usually built whenever a long line of laterals, with a considerable fall, empties into a main with less fall. They are usually built so as to leave a clear space, one foot in diameter, in the center. They are generally built of brick for the first two or three feet, and finished with a round sewer pipe set vertically. The ends of the pipes emptying into the drain are two or three inches above the end of the drain flowing out, so as to make a break in current and thus cause a deposition of silt.

To retain this silt the bottom of the silt basin is about ten inches below the end of the drain flowing out.

They are also very useful when it is desirable that several sub-mains or branches should join at one place, and there unite in one line as an outlet to the whole system. They also permit us to unite several drains entering at different angles without the objectionable feature of short turns; and then there is great satisfaction in being certain that all is going right, and in watching the operation of our subterranean works. The water of thorough drainage is usually as pure as spring water, and such wells, when made larger in diameter, may often be conveniently used as places for procuring water for both man and beast, a consideration well worth a place in arrangements so permanent as those for drainage.

Size and Location of Drains.

Have your main large enough so the whole territory of which your main is the outlet can be thoroughly drained. If you don't believe in thorough drainage now, you are likely to change your mind in the near future. A few cents more expended at the start will be dollars saved later on. With rare exceptions persons, after seeing the wonderful results from their first drain, want to run other drains connecting with this outlet drain, and any failure in the construction of your first drain means discouragement and waste of means.

Another common error to be avoided is locating drains through a field promiscuously or in a hap-hazard way, following

small depressions without taking any thought whether drains then being put in will drain the land sufficiently or not, thereby rendering thorough work impractical without a loss of labor when in many cases the lay of the land would admit of parallel drains at whatever distance you may choose to put them in. Locate the main drain at the foot of the slope or in the lowest ground where you can secure the greatest number of laterals running parallel to each other and at right angles, or if possible at an angle of 45 degrees from main. At first put in branches through the wettest ground, remembering to keep them parallel, and if your faith or purse is not strong enough to do thorough work at first, construct your drains at any distance apart you may feel justified in doing and you leave the field in shape to add other drains in the future as your faith and money increases for more thorough work.

Placing the Tile.

No matter how complete the workman may leave his job there sometimes happens from the washing of the drain bed little depressions caused by the unequal quality of the soil such as is made by a stone, or sand pocket. These must be carefully filled up so the tile will rest firmly on the bottom. If a stone protrudes itself but a *trifle*, but so as to cause the tile to rock, or lay unsteady, either settle it by driving in the ground or remove it.

Where there is abundant fall, the tiles may be very much smaller than on level land. Where but little fall can be obtained the drains should be as long as possible, and the tiles small enough to be frequently flushed to their fullest capacity with water. A 3-inch drain tile 100 rods long will contain nearly 7,000 pounds of water; and even if the grade is but a slight variation from level, (as 1 inch per 100 ft.), the weight of the water will create a velocity of sufficient force to wash the tiles clean inside, if the outlet is kept free from obstructions. In a long ditch the tiles at the upper end may be smaller.

Filling the Ditch.

Filling the ditch after the tiles are placed used to be, when they were wide, a rather serious undertaking, but now that drains are only cut wide enough for the tile, not so much earth to return, and that done by horse power, the filling up is not so formidable a job. The best implement and the one that will do the work the best, easiest and quickest is one that can be made in less than an hour and at a small cost. Take two planks 10 ft.

long and 2 inches thick and 14 or 16 inches wide; place them on edge eight feet apart at one end and eighteen inches apart at the other. Place a 2 x 6 joist 10 ft. long, one foot from end of the plank at wide end and spike it solid; place a 2 x 4 near the narrow end. Both the 2 x 6 and 2 x 4 should project over the plank one foot to admit of a brace nailed on under the cross pieces and outside of the plank. This done you are ready for business. Use two horses, one at each corner of the wide end. With the dirt equal on both sides of the ditch, two rounds will generally fill the ditch rounded full. This machine is worth all it costs, if you have but thirty rods of ditch to fill.

The farmer who has had faith enough in tile drainage to construct one or a number of drains on his farm should have pride enough and place value enough upon the work done to prepare a map showing the location of every drain on his farm. This map is of value more ways than one. If you have done considerable tiling you are apt to forget where some drains are. If you do, by reference to the map you can locate them. Then, too, it would be a source of satisfaction to know the number of rods of tile on the farm, and size of tile in each drain and the amount of money you have on deposit. The drawing of such a map, I might say, is within the ability of almost any farmer.

First take the dimensions of the farm. If you have it fenced into fields, lay off each field; show location of house, barn and other buildings; mark the streams and large open ditches; then locate your main drains, and so on until you show the location of every drain on the farm. To do this it will be necessary to take some measurements giving distance from one point to another, so as to mark each drain, and draw the entire map true to scale. As the work progresses in after years, mark each drain upon the map. A list of tile may also be kept on the same map, and each drain can be marked, showing the number of rods and size of tile.

Open Ditches.

The necessity of the number and the size of the open ditches deprives the planter of a good amount of land, in many cases equaling one-tenth of the acreage in cultivation. This is not only waste land, but a source of trouble also. The liability of filling up of the open ditches causes an annual outlay, which in a few years would, in connection with the redeemed land, pay for the tile drainage. The sides of the open ditches grow up with

weeds, which must be cut down to prevent them from going to seed, and stock the whole field with weeds. Then, again, where open drainage is in vogue, quarter drains have to be dug and cleaned out after every working of the crop; enough of the trouble and expense connected with open drainage to induce every agriculturist to supersede it with tiles.

But the greatest inconvenience caused by open ditches is that they cannot be crossed except where they are bridged. All these drawbacks are overcome by tile drainage, which if once established is permanent. The ditches being filled, fields can be cultivated in sizes to suit; no more quarter drains to be cut, no more old ditches to clean out, nor will there be any more weeds growing along the banks of the ditches.

Tile Drainage and Fertilizers.

The money which is annually spent for fertilizers is something enormous, and the trouble is the expense recurs every year; there is no letting up on it. Tile drainage when once properly done, is done forever. It is about the only thing that man can make that does not deteriorate with age, but in fact, as is admitted wherever tried, gets better with age; that is, the good effects of it spread further every year, the ground is made more porous and dry further off and deeper down. As between fertilizers and tile drainage, if a farmer could afford only the one, we believe he could do better without the fertilizer than without the tile. No matter how rich the land naturally is or has been made artificially, if it is water-soaked a good share of the year the plant-roots cannot assimilate it or use the strength there is in it.

The Effects of Drought on Drained and Undrained Land.

At the cursory view it would be seen that draining water from the soil produced drought. But the most ordinary experience teaches a different lesson, no science being required, although we must depend upon science to explain the apparent inconsistency. It is never pretended that drainage is always proof against drought, but this is certain, that the driest soils are the most benefited by being drained.

Let us make a starting point of the fact that the porosity of the soil depends upon the quantity of water in motion and the rapidity with which it moves. This condition is, of course, increased by tillage, and it explains the reason why drains do not

produce their best results for several years after their construction. Porous soils admit air as well as water, and we shall first consider the relation of the atmosphere to soil moisture. The quantity of moisture does not vary; if it is not in the soil it is above it in the form of vapor. Heat, by expanding the particles of water, keeps them in the vapory form, and when the vapor strikes the cooler bodies, heat is abstracted, the particles contract, re-unite, and being heavier, descend in the form of rain or dew. When the soil is rendered porous by drainage, tillage or the constant motion of the water it contains, the vapor enters the air and the soil being the cooler, the vapor is condensed and absorbed by the soil particles, furnishing not only moisture, but also fertility. Apart from the benefits of moisture there is both a direct and indirect gain from a fertilizing view; the air not only furnishes plant food directly, but is also the means of preparing the raw store of food already in the soil. The quantity of vapor condensed and absorbed by different soils differ very materially; the finer the particles the greater the moisture. Soils may therefore be classified in the following order with respect to their capacity to obtain moisture from the atmosphere; viz: humus, clay loam and sand.

There is still another source of soil moisture, more important than that which we have just described. In dry weather the water table furnishes an inexhaustible supply of moisture which constantly ascends by capillary attraction just as oil runs up a lamp wick. Here are two very important points for consideration: (1) The soil must not be too fine, as is the case with stiff clay, else capillary attraction will act very weakly, and if the soil is too coarse, as is the case of coarse sand, the attraction of gravity overcomes that of capillary, and the water will not rise; a proper mechanical texture must therefore exist in the particles of soil; (2) the drain should be so regulated with regard to depth that the underground water below the influence of the drain will easily rise to the feeding roots, evaporation being prevented as much as possible. This motion of water always plays an important part in relation to fertility. Soluble matters of the soil or of the manures are carried up with water to the roots of the growing crop, the water therefore acting as a distributor in the freezing and thawing process. If exposed to the air for a time this process goes on until the soil assumes a degree of firmness obtained in no other way.

Now, if we examine a piece of frozen soil which was satu-

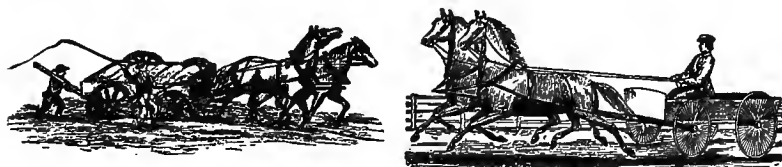
rated with water when freezing, this porous structure will be wanting. The cavities between the particles of soil were completely filled by the excess of water. When the lump thaws there is a mortar-like mass in which the particles run together, so there is no practical gain to the soil by the action of the frost during the winter.

Apply these two facts to our field soils. In a well-drained soil the frost penetrates far down into the subsoil, making the crystal of its moisture expand the particles of which it is composed, having room to do so because of the air spaces between the particles, and that, too, without entirely filling the pores of the soil. Air may still circulate through the soil, carrying with it heat and moisture. Should there be thaw in winter, surface water will find its way into the drains as soon as the surface ice-crust, if any exist, is broken. It is different with undrained soil. Frost places an effectual seal which is made all the more secure as the degree of cold increases. For want of space between the particles, the soil expands bodily, carrying everything with it and it is rendered inert or dead except such portions near the surface as may be acted upon by the sun and air. Frost does not penetrate as deep into this as it does into drained soil, and air is so shut off from all except the surface, that when spring thawing begins, the advantage gained to the soil by frost influences is largely lost, because it has too much water, and as necessary consequence, too little air. To render this more obvious compare high land in spring and the low undrained land. The former is loose and mellow upon the surface, the latter is compact and sodden, its character in this respect depending altogether upon the amount of drainage given it. These influences, which make our upland soil the delight of the cultivator, and the bearer of plenteous harvests, extend the entire range of a well-drained soil, be it high or low land, the subsoil in a measure, similar to that of the surface.

This is the winter as well as the summer work of drains. Its value has been observed by all who have practiced the laying of the tile drains both in autumn and spring. The drained soil is said to "work up" much better and easier, and to raise a larger crop the first year than the spring-drained land. Why? It has had better preparation, and in reality contains more available plant food. It has been in winter-fallow, by which new soil has been made and the old renovated.

Underdrainage in Clay Soil.

The effect produced on a clay soil by drainage is to render it porous. The direct and immediate object of taking the water out of the soil is to let the air in. This result follows drainage more or less immediately in proportion to the strength, or tenacity of the clay. In very strong clay, but little effect is observed from tile drainage the first year, but the usual heat of summer extends the drying process more or less, and the clay losing its saturation shrinks, and cracks extend out from the drain on each side, and these are never entirely closed afterward, but remain as channels conducting the water to the drain whenever saturation occurs. This process, continuing year after year, the once solid and compact clay becomes ultimately broken up and its pores admit the air to traverse it freely, and the more so as the weather is drier.



The Use of Drain Tile for the Improvement of Public Roads.

Roads have always been regarded as accurate tests of the degree of civilization existing in a country. Their improvement keeps pace with the advances of the nation in numbers, wealth, industry and science, affording to the historian an evidence of progressiveness in all those things which go to make up the financial prosperity of a people.

The object to be sought in a road is a hard, smooth surface, impervious to water. McAdam, the English engineer and famous road builder, constructed his roads by first thoroughly draining the road-bed; then it was properly shaped and sloped from the centre so as to discharge what water might penetrate to it. Upon this was placed the broken stone by a method peculiar to himself. We may place thorough drainage as being, both figuratively and literally speaking, at the foundation of good roads.

In draining for a road we have a different object in view from the one had when land is drained for farming purposes. In roads we care nothing for warmth of soil, porosity, or any other quality which fits a soil for producing crops. We wish to

remove the water from in and around the embankment and keep it away. In times of large rainfall we must remove the water with the greatest possible rapidity. It has been proven by sufficient trials that the use of drain tiles is of the utmost advantage; in short, in accomplishing these objects underdraining is the key to successful road-making over the land.

As with everything else there is a right and a wrong way of doing this, and it is poor economy to do poor work on a public road in order to save a few dollars.

Roads can be very materially improved, at an expense entirely within the means of all. By all means have stone roads as soon as possible; but first prepare a place to put the stone, to insure against the chance of losing it in mud unfathomable. For the sake of illustrating, let us suppose that we are going to make an entirely new road. After the road is located we will stake out the track, which should not be more than 20 ft. wide. After this is done, let a competent man stake out two lines for tile drain, each a few feet from the centre of the roadbed. Then tile should be laid to a perfect grade, not less than an average depth of three feet and carried to the nearest outlet, no matter what the distance or what the expense. This is an absolute necessity, as without efficient tile drainage there can be no good road built either of stone, gravel or any other material that is accessible. After the tile are laid as above directed, proceed to raise the roadbed about 15 inches in the centre and 8 or 9 in. at the outside, by scraping upon it the surface soil. It should then be made perfectly even and smooth. No hillocks or hollows should be allowed under any circumstances. It will then be a good plan to go over it several times with the heaviest rollers and make it as compact as possible. Then dig your side ditches with the same care as to grade and outlet as it was done with the tile. These open ditches need not be deep, but should be so graded that no water will stand in them to soak and soften the bed of the road. They will carry off the water that falls upon the road while the tile will carry that which comes up from below.

In order to keep this road in good condition, appoint a man to go over it every day in the wet season and draw off the water from puddles that may form on the bed of the road and fill them up, and also to keep the side ditches in good working order. The road should be completed as early as the middle of August, so that it may be well settled before the fall rains set in. Let the

above principles apply to old roads. The roadbed need not be raised more than two feet above the general level unless in crossing a low place.

After you have constructed your road in the above manner, you have a foundation upon which you may build your stone or gravel road, which you may delay doing until you feel able to bear the expense. When you wish to put stone on the road, make it 12 inches thick at the centre and 6 or 8 at the side; the width should be from 12 to 15 feet. This done, you have a road that will be a pleasure to travel on at any time in the year. Farmers can then sell their produce when the price is most satisfactory.

Drainage for Fruit Trees.

At the present season of the year the drainage of wet portions of orchards and gardens can be performed with particular advantage. We had occasion to witness repeatedly the ill effects of water in the subsoil through all the early part of the season. Yellow foliage, poor growth and unproductiveness are some of the results. If the manure has been applied, or if the soil has been enriched in previous years, the water excludes the air, and the manure is of little or no benefit. These unfavorable influences are greater and more common than is generally supposed. In a ride recently through a peach-raising region, we could not but observe the feeble and sickly appearance of the trees on all the lower portions of the orchards which had not been underdrained, contrasted with the deep green of other orchards which stood either on land having a natural drainage or which had been regularly tiled. A vineyard was shown us, a portion of which had been planted on sloping wet ground, and did not succeed well. Tile drains three feet deep were placed midway between the trellises, after which it became an excellent vineyard. In England they do much by trenching, but draining must be added. The Gardener's Chronicle relates an instance where apples and pears were planted on heavy clay, which had been trenched down to "an iron hard pan." The trees made no growth, and moss and lichens grew on them. The orchard was then thoroughly drained. In six months the lichens began to disappear, and the next year a fine growth was made. The soil had been warmed by the drainage, and the fertility had been made accessible to the growing roots.

Underdrainage and Sheep Husbandry.

Drained land is just what the sheep-raiser desires — sufficiently dry. Grass starts up on drained land two or three weeks earlier in the spring, on account of the greater warmth of the soil, than on undrained land. The early grass is quite an item in lessening the expense when you come to count the profit and loss of the business. Quite as much is gained in the fall season, for the grass continues growing several weeks later. Thus a farmer gains at least a month in the length of the season by draining his land. When we can shorten the feeding one month it is so much gained, and adds to the profits of the business. This alone would pay a farmer to drain his farm; in addition, the sheep-grower need not fear the drought, for his pastures will make a steady growth of grass, even in dry weather. Every dew or rain is utilized, and the rising moisture keeps the grass growing; the flocks thrive on account of abundant food.

Quite the reverse of this takes place where the land is not drained. If a drought lasts any great length of time, the pasture is short, the owner hopes the drought will not last long, and does not dispose of any of the flock, and they become thin in flesh. The crop of wool is injured by a weak wool fibre, that is, the secretion which supplies the matter of which wool is formed is lessened, and the fibre is weakened at that particular point. If this adverse condition continues for some days or weeks, the weakened fibre forms what is called a "break in the wool." When the wool is to be carded or combed, the resistance of the fibre is not equal to the tension required and it breaks at the weak spot, which decreases its value very much.

There is no animal that derives such a benefit from draining as sheep; even man does not in a sanitary point of view, as do the shepherd's flock. By drainage so many destructive diseases that destroy thousands of sheep annually, are entirely eradicated. All foot diseases are easily cured where sheep have dry pasture land to run upon. Disease is sure to follow where sheep have wet feet any length of time. Of all diseases that affect sheep parasitical diseases are the worst. A farmer may have a fine rolling hillside farm with a good spring, but if he has stagnant water here and there along the water course, it would be the very place to destroy his whole stock. Open ditches are as dangerous for the same reason.

Drainage for Pasture Lands.

Very few persons have thought of the necessity of under-draining pasture lands, that tame grasses are not wont to stand with their tiny feet in water any more than cereal plants. Some have observed that the grass on the low ground is taller and apparently more luxuriant; but the stock graze upon the higher ground and shorter grass, for the reason that it is sweeter and more nutritious. Put in a few underdrains in the low land and the stock will soon change their feeding grounds to the grass growing above the drains. Drainage will improve the character of the grass, strengthen the sod and relieve the soil of water-loving plants or swamp grasses.

There probably are some reasons why this matter of tile drainage has not progressed more rapidly among the farmers.

Many things spread among them like wild-fire, but this has taken a more steady and solid growth. A first reason why farmers delay this improvement is, that they are ignorant in a great measure of its results. With too many farmers it is true that they are distrustful and require a visible proof of results before they will fall into line with this march of improvement. With them, seeing is believing, and any amount of printed testimony would not affect their opinions. If neighbor A tries it and it does well on his farm, then I will try it. I must see it before I will believe the marvelous stories told of the benefits of land drainage.

A second reason why farmers do not more readily enter into this work is because, after having become convinced of the efficacy of the work in other places, they are timid and over-cautious about going into this sort of an investment; they lack *courage*, because farmers have sometimes made mistakes.

Irrigation.

The subject of irrigation is of far greater importance to our people than many suppose. We have a soil of wonderful fertility and adapted to a large variety of vegetables and fruits, as well as grain, and if we could but have rain in sufficient quantities and at regular intervals, large quantities of products and of the finest quality would be annually grown, which would bring health and happiness, and inflate the now collapsed purses of many toiling husbandmen. As it is, many plant skillfully and with hope, but reap disappointment. Happily irrigation comes to the rescue.

The absolute necessity of water to vegetable growth must

not be accepted in an unqualified sense. Water is a good and necessary thing, but there may be too much of it, and too much is as fatal to the profitable culture of land as too little. As the circulation of air brings life and vigor to the lungs of an animal, so the circulation of water brings vitality to the roots of a plant. Stagnant water is as fatal to plant growth as stagnant air is to the health and well-being of animals.

Perhaps no one suffers more from drought in this country than market gardeners; we therefore appeal especially to them to give this matter their thoughtful consideration. It seems not too much to say that in four summers out of five the rainfall through July, August and September is far too light to enable a gardener to grow more than half the crop that sufficient moisture would enable him to produce. But irrigation cannot be successfully used without first thoroughly underdraining the land, and, if possible, have the drains about three feet deep.

On a ten-acre plot of fruit and vegetables an irrigation outfit will pay for itself in one dry year.

This is especially true of under-irrigation, which consists in laying drain tile in lines 8 or 10 feet apart at a depth of 12 or 15 inches at almost a level or very slight fall, so that the flow of the water will be very slow along the line of the drain, passing out at the joints of the tile into the soil among the roots of the plants just where it is needed. The sizes of tile generally used are either 2, $2\frac{1}{2}$ or 3 in. for the side drains, and from 4 to 8 in. for the main drains. The tile in the side drains are usually placed from $\frac{1}{4}$ to $\frac{1}{2}$ inch apart in order to allow the water to get out more freely, and the joints are covered with collars to prevent the dirt, etc., from entering the tile. This will give much better results than surface irrigation, for the reason that the cultivation may go on without hindrance and the soil will not compact.

The improvement once made will be permanent. The drains should have outlets to allow any excess of water from heavy rainfalls to pass off without injury to the crop.

While it is expensive to fit up a garden plat or a few acres, it will make the work of growing vegetables and small fruit a certainty and remunerative, if well managed, in a suitable location. By a suitable location, we mean market conveniences, where the small fruit and vegetable products bring good prices, with but little cost for transportation.

Why the Round Tiles are Better than Other Forms of Tile.

We have, sometimes, to contend with quite a strong prejudice from persons not familiar with the Round tile, yet invariably find that, when once fairly introduced, these same persons become their warmest advocates—entirely discarding the Sole and Horseshoe tile.

We have adopted the Round tile, believing it to be the only correct form tile should take; and in this we are sustained by the precepts and practice of scientific engineers, both in this country and England, who have made the business of drainage a study. French, in his work on "Farm Drainage," says:

"The simplest, cheapest and best form of drain tile is the cylinder, or merely a tube, round outside, and with a round bore."

The Round tile have greater strength than any other form. Being a perfect arch, they will stand almost any amount of crushing force without injury. Perhaps the strength of this form will be more forcibly illustrated by referring to the tubes of a steam boiler. The thickness of iron in a three-inch tube is only about one-tenth of an inch, yet it will safely stand a crushing pressure of one hundred pounds to the square inch.

The Round tile are sprung less in drying and burning. As the walls of the tile are of uniform thickness in all parts, they have not that tendency to warp out of shape, which other forms of tile have. Should they become warped from any cause, they can be laid any side up, so as to make a more perfect joint at their ends, and form a straighter or more level run for the water—both of which are important.

The Round tile are the only kind well adapted for the use of collars on the joints—the use of which is thought by some engineers to be almost indispensable when the very small tile are used. We quote from Waring:

"Experience, in both public and private works in this country, and the cumulative testimony of both English and French engineers, have demonstrated that the only tile which it is economical to use, is the best that can be found, and that the best thus far invented, is the pipe or round tile, and collar."

It must be seen, upon a moment's reflection, that the Round tile have greatly the advantage over the flat bottoms, as a water-course. An amount of water that would spread itself over the flat bottom and trickle lazily along, without power to move the least obstruction, would in the Round tile, form something of a

current, capable of carrying with it particles of sand and sediment, which would remain in the flat bottom, and in due time greatly reduce its capacity if it does not render it entirely worthless.

The capacity of these two forms to remove sediment has been perfectly demonstrated in the building of sewers. Where a flat bottom sewer was found to deposit a large amount of the sediment, upon changing it to the round form, of same size, the sediment was found to be carried out with the current.

We would also state that the Round are much lighter in weight than the Hexagon tile. The reason for which can be seen by observing cuts of the kinds mentioned. The extra weight on the Hexagon tile, of course, adds greatly to the freight charges.

We have stated only a few of the many reasons in favor of Round tile, but trust we have said enough to convince any one of their superiority over the flat bottom, who will give the matter a few moments' candid reflection.



Collars.

The above cut represents tile fitted with collars. Collars are merely short sections of tiles of such sizes as to fit upon the smaller ones loosely, covering the joints, and holding the ends in place, so that they cannot slip past each other.

If collars are used there is less difficulty in adjusting the tiles, so as to make the lines straight, and far less obstruction by sand or roots. Water will enter the drain far more freely, for the space between the collar and the tile on each side of the collar is open, and affords no resistance to entrance of water.

In draining in the neighborhood of trees, collars are also supposed to be of great benefit, in preventing the intrusion of roots into the tiles, although it may be impossible even in this way, to exclude the roots of water loving trees. From the above we do not wish to convey the impression that the Round tile should never be laid without collars, for while there is no question about them being a good thing, and in many cases an actual necessity, yet in clays and other clean cutting and firm bottomed soils, we do not find collars to be at all necessary, and in such cases are rarely used by parties who wish to avoid an unnecessary expense. On an average not over one in every 100 of our cus-

tomers use collars on the Round tile larger than 3-inch. When ordering collars, parties will frequently order collars for 2-inch and none for the larger sizes.

Horseshoe Tile.

As the Horseshoe tile are open at the bottom, it is necessary to lay them on boards. A careless ditcher is very apt to leave bottom of ditch very uneven, knowing the boards will give him a smooth surface on which to lay the tile, and cover the hollows which he has left in many places along the bottom of the ditch. It will be readily seen, that the result of this will be, that weight of earth will cause board and tile to settle wherever there is a hollow, making fall of drain very uneven, or it is very apt to displace the tile, making drain partially or wholly worthless.

We have stopped making the Horseshoe tile, they being so inferior to other kinds; very few of our customers would take them at any price.

The Hexagon Tile, as will be seen by cut, has six flat sides on which they can be laid instead of two, as in the old style Sole. Thinking that these Hexagon Tile would be more satisfactory than the Sole, I have adopted them and have stopped making the Sole.

Being the oldest and most extensive manufacturer of Agricultural Drain Tile in the United States, I am prepared at all times to supply any quantity, kind or size of tile, at prices that defy any other parties to undersell me. Tile delivered free on cars or boat in this city. Particular attention given in shipping to guard against breakage.

Estimates and contracts made for draining Parks, Country Places and Farms, guaranteeing every satisfaction. Experienced workmen furnished to parties desiring to do their own draining.

I have put in new and improved machinery, and greatly enlarged my works, which has enabled me to manufacture a far superior Round and Hexagon Tile, and at a lower price than any offered to the public heretofore.

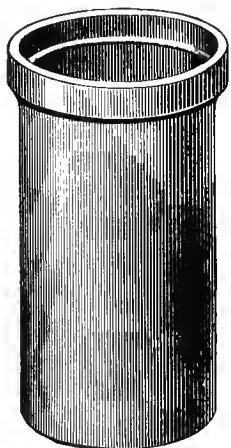
Although there is no doubt about the Round Tile being superior to all other forms of tile, I would call the attention of the reader to my new style of Sole or Hexagon Tile. They have six soles, consequently can be turned end for end, or laid on any of the six sides until perfect joints are made. They are always very strong and smooth.

Feeling assured that my tile far excel any others made in this country, I would be pleased to send samples of the same to parties who contemplate purchasing; also to have them send for samples from other manufacturers, and compare them with my tile and prices. My tile wherever exhibited have always taken the first premium.

AGENTS WANTED.

Vitrified Pipe Wells.

Physicians and others have within the last few years frequently called attention to the general unsanitary condition of our wells, and while some good has resulted, there still remains a great deal to be done.



As our wells are covered up, we are very liable to forget or overlook to examine into their condition. As we do not see down into them, we are apt not to think of anything being wrong until there is sickness or death in the family. Bad drainage and impure well-water are the causes of nearly all cases of typhoid fever, diphtheria and malaria. Putting the well in first-class condition so that it will remain so for many years will not begin to cost as much as one sickness.

A few wells are built of stone, but nearly all of brick. To every foot of depth in a brick well two feet in diameter there are thirty-seven feet of mortar joints. No matter how good the material or workmanship, there will be some small holes through which surface water, insects and worms will enter the well. As brick are porous, surface water will enter, even though every joint is tightly cemented, thus making the water already there impure.

My Vitrified Pipe are highly recommended for lining wells. They are two feet long, and, as they are vitrified, nothing can get through them; and if they are carefully put down, with joints tightly cemented, they will keep the well clean and pure, and will be as good a century after as when first put in. The sizes most generally used are 15, 18, 20 and 24 inch in diameter. They not only make a much cleaner and more durable well, but are very much cheaper than brick or stone.

10 inch Pipe per foot									\$.75
12 " "	-	-							1.00
15 " "									1.35
18 " "	-	-	-						1.70
20 " "		-							2.25
24 " "	-								3.25

The above prices are subject to large discount, even on small orders.

Letters From a Few of My Customers.

**From Theodore Wirth, Superintendent
for City of Hartford Department of Public Parks,
Hartford, Conn.**

Oct. 14, 1901.

DEAR SIR:—Your letter of the 9th inst. received, and in answer to your inquiry as to the quality of your tile, I wish to say that I have found every shipment you made to me entirely satisfactory and of standard quality. As to the beneficial results derived from the underdraining of wet and low land, there is no room for question or doubt about it.

We have laid forty (40) miles of drains in three of our principal parks, the results being, as intended, that two hundred and fifty (250) acres of swampy, retentive and practically useless land have been turned into beautiful, healthy and productive parkland. Our most attractive meadows, faultless lawns, and healthy groves and woodlands, owe their very existence and their satisfactory condition and appearance to the underdraining given them.

Mr. James Hagan, whom you recommended to me for the execution of the work, is an expert in the business. He is a very conscientious worker, and does only good work from beginning to end, and if I have some more draining work to do in the future, it will be done with Jackson tile and Hagan workmanship.

**From J. N. Shannahan, Engineer
for Fonda, Johnstown & Gloversville Railroad Co.,
Gloversville, N. Y.**

Dec. 18, 1901.

DEAR SIR:—Replying to yours of the 16th inst., it gives me great pleasure to testify to the uniformly courteous treatment which we have received at your hands.

Regarding the character of the vitrified and agricultural tile which you have furnished me from time to time, I can only say that I regard it as excellent. I might add that the extremely low percentage of breakage indicates great care on the part of the shipper.

**From Robt. Scott & Son,
Rose Growers,**

Sharon Hill, Del. Co., Pa.

Dec. 19, 1901.

DEAR SIR:—The car load of drain tile which you shipped us some time ago, gave such good results that we are thinking of ordering another carload this spring. Permit us to compliment you on the good quality of the tile furnished, and also on your method of shipment.

**From L. E. Harrower.
Amsterdam, N. Y.**

Dec. 19, 1901.

DEAR SIR:—In reply to your favor, wish to say, that I have used large quantities of your drain tile, and have always found them perfect in shape, well burned and in fact satisfactory in every respect. Would also say that the benefit to be derived from draining is beyond question.

The drains that I have put in, have made out of a practically

worthless piece of ground, one of the most productive pieces on my farm. If, at any time in the future, I am in need of any drain tile, I certainly shall send you the order, as I feel sure that your tile are equal, if not superior, to any other tile on the market.

**From Wendel Andreas,
Valley Farm,**

Hackensack, N. J.

Dec. 20, 1901.

DEAR SIR:—My experience with your Round porous tile for land draining has been most satisfactory, making land tillable early in the Spring that previously could only be plowed in Summer.

Another purpose to which I have put the porous tile is for house drainage in clay soil where cesspools were unsatisfactory. The six-inch tile laid one foot beneath the surface, with a 20-foot main and 10-foot branches, can handle the sewerage from a large house for two years, and then at a slight expense can be moved two or three feet and relaid, being then as servicable as ever. This method of sewerage does away with a costly cesspool and will keep the lawn under which it is laid well fertilized.

**From A. A. Brigham, General Manager,
Cornell Incubator Mfg. Co.,
Ithaca, N. Y.**

Dec. 21, 1901.

DEAR SIR:—Your favor of Dec. 16, addressed to me at Kingston, R. I., has been forwarded. Relative to the benefits of drainage I would say that on the College farm at Kingston we had a very finely comminuted, tenacious clay which held the water most stubbornly. The effect of the use of Jackson's Round tile drains on this soil was very beneficial. We liked the quality of your goods and your method of doing business.

We wish you continued and increasing prosperity.

**From Geo. T. Philcox, Manager,
Elm Court Farm,
Lenox, Mass.**

Dec. 22, 1901.

DEAR SIR:—In replying to your request as to my opinion of your tile, and of their efficiency in reclaiming otherwise worthless land, I can only say that I am more than satisfied with the results obtained through their liberal use. We have used two carloads in all on a piece of land which previously grew nothing but weeds and water grass; in fact, was almost a swamp. The draining was done in late Summer, sufficiently early to plow and plant rye, and now I have as pretty a piece of rye on that same land as one would wish to see.

The value of land draining cannot well be over-estimated, and although the first cost is frequently the obstacle to its more general use, the results generally produce the very greatest satisfaction as an investment. Your tile I consider the very best that is made, and in future operations of this nature I shall always use it.

**From Prof. Wm. P. Brooks,
Massachusetts Agricultural College,
Amherst, Mass.**

Dec. 24, 1894.

DEAR SIR:—During the past six years we have put in on the Agricultural College farm something like nine miles of tile drains. We

have used your round tile exclusively in sizes from 2 in. up to 10 in. For thorough work we have put lines of 2 in. tile at a distance of 30 ft. apart in clayey land and at a depth of three to four feet. The results are satisfactory. On a part of the land so drained, we had in this very dry year — rainfall only one-half the average — yields at the following rates : corn, 10 acres — 1042 bushels shelled grain ; potatoes, 4.6 acres — merchantable tubers, 1103, small tubers 150 bushels ; grass and clover, 6 acres — hay 15 tons, rowen 6 tons. This land is so drained that even in a wet season it will give good crops, as we know by experience. Thorough tile drainage, beyond a doubt, will do more than anything else to prevent injury either from floods or drought.

From Wm. S. Egerton,
Landscape Architect and Sup't of Parks.,
Albany, N. Y.

Dec. 31, 1894.

DEAR SIR : — I think good tile drainage one of the most essential features contributing to the success of agricultural pursuits, on retentive soils ; the construction of good country roads ; the proper sanitation of malarious districts, and the general conditions usually found a hindrance to the proper growth and development of the greater portion of vegetable and tree growth.

In my experience, as a landscape architect and civil engineer, extending over a period of twenty-five years of active work, in the design and improvement of urban and suburban grounds, I have found the use of tile drainage the foundation for effective and permanent construction. The money and labor expended has never been misapplied, and the results have been, in many cases, many times beyond those anticipated. The adverse criticisms, if any, originate largely in ignorance, and because of an improper method in the use of the materials at hand.

Tile drainage should be properly planned and properly executed to obtain satisfactory results, and where otherwise introduced cannot but prove unsatisfactory and disappointing, if not altogether useless.

Your tile, both agricultural and vitrified, are standard in the market, and have given entire satisfaction wherever I have used them.

From Spencer Trask,
of Spencer Trask & Co., Bankers & Brokers,
New York.

Jan. 5, 1891.

DEAR SIR : — In reply to yours of the 29th, requesting my opinion as to the quality of your tiles as furnished me and the result of their use, I take pleasure in assuring you that they have proved thoroughly satisfactory. I think that I have, during the past five or six years, used at least four carloads of your tiles, and have found them most efficacious, the quality most satisfactory, and the result produced by their use all that could have been desired.

From James J. Powers,
Contracting and Sanitary Engineer, 52 New St., New York.
Main office, Peekskill, N. Y.

March 21, 1890.

DEAR SIR : — In reply to yours of the 17th inst, I take pleasure in stating that I have used several hundred thousand of your Land tile in

irrigation beds, for sewerage, effluent disposal and drainage. I have always found them to be of superior quality and finish.

I desire also to acknowledge your promptness in filling my orders, for which please accept my thanks.

**From Edward Burnett, General Manager
for H. McK. Twombly, Madison, N. J.**

Dec. 19, 1894.

DEAR SIR:—In reply to your letter of the 18th inst., I write with pleasure to say that we have used a great many miles of your tile on this estate and have found them most satisfactory. We have a very retentive clay soil and the good results of land drainage have been most marked. This last season we obtained as high as four tons of hay on some of this reclaimed land.

**From F. Mangold,
Manager, Jay Gould Estate,
Irrington, N. Y.**

Feb. 25, 1890.

DEAR SIR:—I received your favor of the 24th inst., and in reply will say that it gives me great pleasure to express in a few lines my satisfaction with your goods. I have bought and used of your tiles several hundred thousand feet for the drainage of the large estate of Mr. George Merritt, now owned by Mr. Jay Gould, and also to drain the Thaldan Swamps, likewise owned by Mr. Jay Gould, an undertaking successfully carried out, and has proved to be a great benefit to the neighboring places, as we can drive over that swamp now with horses and wagons on places where it used to be a regular lake all the year round. I have used from 3 to 8 inch tile. In former years I used the Sole tile and also the Horseshoe tile, but of late I have used the Round tile with sleeve collar, and I have found it to be the most beneficial one in any respect. I can recommend the tiles manufactured by you as the best in my experience.

If any one should wish for details, I am willing to give all information.

**From Carrol Phillips Bassett,
M. Am. Soc. C. E., Newark, N. J.**

Feb. 28, 1890.

DEAR SIR:—I am very glad to assure you of my appreciation of the quality of your tile, which I have used in my professional work. At the East Orange, N. J., sewage purification works, where between 15 and 20 miles of your tile was used in sizes ranging from 2½ to 6 inch in diameter, I have secured very successful underdrainage of a tract naturally of close texture, on which a large volume of sewage water—effluent from chemical precipitation tanks—is daily poured.

This whole question of land drainage—soil drying and warming—is but poorly understood or appreciated in this country, and I wish you success in your labors looking to a wider introduction of a class of constructive materials so intimately related to the public good.

**From Francis W. Brewer,
Hingham, Mass.**

Jan. 8, 1891.

DEAR SIR:—After the many carloads of drain tile received by my neighbors and myself it is due to you that I make some acknowledgment of the admirable tile, collars, etc., you make for draining, of the full count

delivered and insignificant breakage in the car, also of your uniformly prompt, energetic and honorable care of your customers' interest.

Wishing you the great success you so truly deserve.

From S. W. Robbins,

Wethersfield, Conn.

Dec. 25, 1894.

DEAR SIR:—I tile-drained, in 1893, ten acres or more with your tile. The land was almost worthless for cultivation before, but has since produced two good crops, and am more than satisfied with the result. Can say that I hope to do more in this line in 1895. I can also say that I consider your tile the best in every particular of any made and shall use no other.

From A. H. Ellis,

Willsborough Point, Essex Co., N. Y.

Dec. 25, 1894.

DEAR SIR:—This present month closes the tenth year of my experience in tile draining in this part of N. Y. State, and have many times intended to write during the past year to tell you how I appreciate the splendid results that have invariably followed the use of your tile. In every instance where I have put in your make I am yet to find the first instance of breakage or stoppage in any line from an imperfect tile or otherwise.

Your Round tile cannot only be laid with greater facility, but affords a perfection of joints and a more firmly bedded line in sand, muck, or any soft bottom than any other make or shape I have found.

I have also had an extended experience in tiling the heavy clay lands so common in this section, where the humus has been exhausted by tillage and impervious when dry, and beyond question, the only method for restoring such lands to a condition for successful cultivation is by tiling. I also find in such lands with ditches of equal depth, and exactly similar conditions (as to size of tile, etc.), that your make does actually produce fully twenty-per cent. more area of friable land than any other make I have ever laid.

Whether it is the kind of clay you use or the process of make that brings the above results I, of course, am not able to say, but with me your tile have been unqualifiedly successful.

Hoping your product will be continued without deterioration

From Samuel Hart,

Doylestown, Pa.

Sept. 10, 1888.

DEAR SIR:—Your tile are all that you claim for them—the best I ever saw. I am delighted with them.

From A. J. Shook,

Spring Mills, Pa.

Nov. 4, 1890.

DEAR SIR:—The tile arrived in very good condition, but few pieces broken. Am well pleased with them. Regarding price and quality, they compare favorably with anything in the tile line I have ever seen.

From A. Taylor, Manager

for W. Seward Webb, Shelburne Farms,

Shelburne, Vt.

Oct. 25, 1889.

DEAR SIR:—We will require more Tile next year, but the enclosed order will fill our wants for the present. The business you have thus far transacted with us has been very satisfactory and we will be pleased to renew any orders for goods that we may require in your line.

From Edward E. Poor,

**Pollfly, near Hackensack, New Jersey,
and 114 Worth St., N. Y.**

Jan. 3, 1895.

DEAR SIR :— During the past few years I have used 50 or 75,000 feet of your drain tile, having by its use drained about twenty acres of swamp and bog, upon which I am now raising large crops of garden and farm produce. Upon one acre which was under water eight months in the year, I am now growing all my summer vegetables, and from it I have the finest specimens grown in this vicinity ; together with a crop of celery of special excellence. I have over ten acres of it laid out in lawn and planted with ornamental trees and shrubs. The land lies along the public road, and the effect has been to turn a wet and unattractive waste into an attractive and beautiful park.

Having practically demonstrated the value and utility of tile draining, I recommend it to anyone having wet or boggy land to reclaim. Its cost bears no relation to the enhanced value of the land.

From C. A. Johnson,

New Providence, N. J.

April 1, 1890.

DEAR SIR :— Your tile are nice and give perfect satisfaction. They are much better than we can get here and cheaper. I have another order for you from a neighbor of mine. He has been using tile from here, but will use no more of them since using yours.

From D. E. Howatt, Manager,

**Crumwold Farms, Archibald Rogers, Proprietor,
Hyde Park, Dutchess Co., N. Y.**

Aug. 4, 1888.

DEAR SIR :— The tile came to hand in good order and are altogether satisfactory to us. Thanks for your care and promptness.

From David G. Yates & Co.,

**Mount Airy Nurseries,
Philadelphia, Pa.**

Feb. 12, 1891.

DEAR SIR :— We wish to say that in all our use of the New York State Drain Tile, it has given entire satisfaction.

From James W. Bullock,

Meadow Brook Farms,

Williamstown, Berkshire Hills, Mass.

Dec. 28, 1894.

DEAR SIR :— In regard to tile draining and the tile bought from you, would say, that the five acres of wet and swamp land which was reclaimed by tile draining, is the most productive land on the farm; also the flat meadow land has been greatly improved by drains. While the first cost of draining, where it is thoroughly done, is seemingly great, the results justify same. I have found your tile satisfactory in every respect.

From G. Howatt, Manager,

Speedwell Farms,

Lyndon Centre, Vt.

Jan. 7, 1895.

DEAR SIR :— Yours of Dec. 19, handed to me by our President, Mr. Vail, for reply. As to the benefits of thorough tile drainage there can be no argument; all the talk would be one way and therefore uninteresting.

You can say that we have used two carloads of your tile, and we are perfectly satisfied with it; fully as good as represented, etc.

**From George F. Beede,
Fremont, N. H.**

Oct. 15, 1889.

DEAR SIR:—Please find draft enclosed to pay bill. The tile arrived Monday all right, only a few pieces broken, quality excellent; will remember you when we want again. They cost about the same here as we would have paid in Boston for a poorer quality. Mr. Ordway will not do all of his job this fall; he may give you a small order soon.

**From W. H. Child,
Cornish Flat, N. H.**

Jan. 13, 1891.

DEAR SIR:—Have used many thousand pieces of your Round tile in draining a portion of my wet land. The results are highly satisfactory in every respect. Enormous crops and easy cultivation where previously it was impossible to obtain sufficient crops to pay for their getting. Your Round tile is just the thing, being excelled by none in quality, and costing less for transportation than any other kind. For fair dealing, I can speak of you in very complimentary terms.

**From L. C. Kinsey,
Montgomery Station, Lycoming Co., Pa.**

Dec. 18, 1890.

DEAR SIR:—Yours of the 13th inst. is at hand and contents noted. The 10 acres which I had drained in Virginia in June, 1888, has already shown marked improvement. Its first crop was wheat, which would have been very heavy except for the ravages of the fly, and this on land where heretofore we never succeeded in raising anything. The tile has given us ten acres of the best land on the place. The drains work perfectly and have given us no trouble. I consider your tile of first quality, smooth, hard and straight, showing no defects or deterioration. We will use more by and by.

**From E. L. Carpenter,
Russia, N. Y.**

Dec. 31, 1895.

DEAR SIR:—Yours of Dec. 18, asking about my experience in tile drainage, received.

Can say that within the last two years have tiled a very wet meadow upon which nothing but a very rank growth of wild grass has ever grown. The past summer I plowed a portion of this field, about six acres in extent, and planted to corn, first applying a moderate coating of manure.

The result was I harvested a very heavy crop, one of the largest in this vicinity.

On account of heavy rains about the usual time of planting crop, this piece was not planted until the 7th to 10th of June.

Have used two carloads of your tile and am entirely satisfied that they are as good as any made.

**From Geo. P. Squires & Son,
Props. Marathon Polled Stock Farm,
Marathon, N. Y.**

Dec. 18, 1890.

DEAR SIR:—In this progressive day and age it seems hardly necessary to advocate the advantages of tile drainage; nearly all who want the name of farmer, admit its advantages, while very many are so driven with work that they never take the time to commence tile draining; presume we

would still belong to that class had it not been for the fact in several of our own fields were a few wet places, which, when under cultivation, were a great inconvenience, to say nothing about the waste of land, and while in pasture were a great nuisance, as cows would tramp in them during fly time and plaster themselves with mud. We attempted to drain them with stone drains, but they caused so much trouble by clogging and filling up, we were induced to try tile. This worked to our entire satisfaction, and has transformed these mud holes into luxuriant pasture and dry tillable grain land. After using several makes of tile, we consider your Round tile the best of any we have ever seen, and think every good farmer should keep a quantity of it on hand, that he may improve all leisure time in laying tile drains until all wet places on the farm have been transformed into dry tillable land.

**From E. P. Lyman,
Warren, Conn.**

Jan. 19, 1891.

DEAR SIR:—Your tile has worked wonders. I have made the best of land where it was not worth anything. I have found that it would pay to put the lines of tile close enough to take the water off as soon as possible after heavy rains. The quality of your tile is good; I had a man of experience lay them and he said they were the best in the world.

**From W. C. Fields,
Sup't Edge Hill Farm,
Stockbridge, Mass.**

Jan. 1, 1890.

DEAR SIR:—I have used the tile manufactured by your firm and find them to be of superior quality; in fact, the best to lay that I ever handled; and at a price within reach of any farmer.

As to drainage, there is no question about tile being better than anything else, at least on our land, as stone drains will fill up in one to five years, and tile once laid are always in order.

**From John Crowley,
Sup't to Joseph W. Clark, Esq.,
Dedham, Mass.**

Jan. 12, 1891.

DEAR SIR:—I can say in reply to your inquiry how the tile drains that I laid last fall and winter worked. The lot I drained on the estate of Joseph W. Clark, Esq., in Pomfret, Conn., contained eighty acres, forty acres of which were so wet that up to the time of haying it was impossible to drive a horse or team over any part of the forty acres without going knee deep. The water, after heavy rain storms, laid in pools all over the lot, which made the grass very sour, so that the horses and cattle would waste about one-half of it by throwing it out of the manger and tramping it under their feet for bedding. The soil is of a very heavy clay or hardpan; after you dig down through the loam about two feet you strike clay or hardpan.

I laid five miles of your three-inch tile. I dug the ditches four feet deep and run the ditches 60 feet apart; I deepened the ditches so the tile would work the whole year round. After the settling of the ditches in the spring I filled up the low places so I could cut the hay with the horse mower. Not only were we able to drive over any part of the lot as soon as the frost was out of the ground, but you never saw such a crop of hay as I

got off the lot. This fall I plowed up the forty acres and sowed it down, and I doubt if there is any other lot in the state that will compare with it. The five-inch outlet after heavy rain storms will run nearly full for three or four days, but the surface is perfectly dry. For economy old stone drains are no comparison. I can heartily recommend to any one who is desirous of draining, not only your tile, which I found to be first class, but the system you recommended to me.

**From John R. Brewer,
Hingham, Mass.**

Jan. 25, 1890.

DEAR SIR:—I wish to take this opportunity to thank you for your promptness and care in all the dealings I have had with you the past six years, during which I have used your tile for draining extensively, redeeming two salt meadows most satisfactorily, and also, among other fields, a steep clay hillside, where natural drainage would have seemed enough, and where your tile effected a great improvement, enabling much earlier planting and teaming than formerly, without causing drought.

Your shipments have always arrived well packed and in very good order. The lands drained can be inspected with ease by any one enough interested to visit Hingham.

**From T. F. Chapin, Supt.
Lyman School for Boys,
Westborough, Mass.**

Dec. 20, 1894.

DEAR SIR:—I have had the following experience of the use of drain tile upon the lands of this institution; three years ago a bog meadow, so made by the conformation of the surrounding hills, would raise nothing but a coarse rush-like grass and could not be cultivated. It had apparently never been plowed. I ditched the piece and laid many thousands of your round tiles. The first year after I was unable to plow it so as to raise any crop, on account of the toughness of the sod, but last year I had an enormous yield of ensilage corn.

The tile seemed to be of a uniform and excellent quality. I have no hesitation in recommending them to my acquaintances.

**From George W. Harris,
Wethersfield, Conn.**

Jan. 6, 1891.

DEAR SIR:—In the summer of 1888 I decided to drain a five-acre lot which about five years ago was only a poor, wet pasture. I wrote you in regard to tile and, as I was obliged to use quite a quantity of 8-inch tile for an outlet through a neighboring lot, I ordered something more than a car-load of your round tile. I have never used your tile before, having used other makes. I found your tile very satisfactory. They are smooth inside and the joints fit well together when properly laid. The work of opening the ditches and laying the tile was well done by your Mr. Hagan, and the help he brought with him, and although we have had two very wet seasons, I have raised good crops on the lot and am well pleased with the investment. Whenever I need more tile I hope to be able to get those made by you.

**From M. S. Bidwell,
Lake Farm,**

Monterey, Mass.

Dec. 18, 1890.

DEAR SIR:—My experience in draining with your tile has been so satisfactory that I shall have to buy another carload for this spring. With your good tile and directions in draining I can make good land of that comparatively worthless.

**From Timothy Herriek,
Manager for Dinsmore Estate,
Staatsburgh, N. Y.**

Dec. 18, 1894.

DEAR SIR:—For the benefit of all whom it may concern I wish to add my mite in the balance in favor of tile drainage. As manager of the Dinsmore Est. since 1857 I have used a great many thousand of the Jackson tile and have found them of a superior quality, and far ahead of the stone ditches my neighbors put in, being less liable to get filled up. I had occasion last fall to relay some ditches put in more than thirty years ago and found the tiles clean and doing their work as well as the day they were put in. Nobody can make a mistake in using tile in place of stone, and there are none better than your tile.

**From James Clifford,
Lenox, Mass.**

Jan. 14, 1891.

DEAR SIR:—Your letter received, and can only say that the tile have proved perfectly satisfactory.

**From J. Spencer Hosford,
Kinderhook, N. Y.**

Dec. 22, 1894.

DEAR SIR:—The last lot of tile received from you was found very satisfactory, as have all the tile received from your establishment. I believe in drainage of wet lands. The expense is not large. Any farmer who keeps his farm in good condition, looking all the while to improvement, must at times have some one or more men who can work at drainage to fill up their time. The consequence is he can see his farm continually advancing in value and not feel the expense.

**From T. S. Cooper,
Coopersburg, Pa.**

Dec. 25, 1894.

DEAR SIR:—I have just finished for the year laying tile drain, having laid many thousand feet, and never had such fine weather to do such work as we have had this fall, and to-day being Christmas, I thought nothing would please you as much as if I wrote and told you of the great success that I have had with your tile, of which I have laid many thousand. I began tiling some fifteen years ago, and to say that my most sanguine expectations have been realized is expressing my opinion as mildly as I know how. We had meadows, as well as fields, where nothing but sour grass grew, and when we were ready to plow the fields we were always prevented from doing so, by having to wait until the wet portion of the field was dry enough to be worked. This often prevented us from getting out our crops on time, and often not at all. However, now such is not the case, as all have been drained.

I had a meadow of some eight acres, on which only sour grass grew; it was always too wet to mow with the machine, and to get it done by

hand was too costly, so at times had to give the entire crop away. It was a great eyesore to me, and I made up my mind that I would drain it. That was two years ago. My neighbors thought that I was wasting a lot of money, and they were astonished, and I must admit that I was agreeably surprised, at the enormous crop of silo corn that we took from those eight acres. I am positive that those eight acres will bring me either in hay or grain as much as any other twenty-four acres that I own. I have found as a rule that where draining is necessary that the very best of soil is to be found, and such was the case in our meadow, the black soil (like a garden) often over two feet deep.

Of the many thousand of your tile that I laid last year we only had one break, and there we were at fault by driving with the heavy silo wagons across the ditch before the tiles were packed. I am more than pleased to say that I have tried tile from different parties, but none have given satisfaction like yours, and I have made up my mind to use no other.

From E. H. Harriman,
43 Wall Street, New York.

Dec. 24, 1894.

DEAR SIR:—The tiles I purchased from you about a year ago, and which were placed in marshy ground covering about ten acres, have given very good satisfaction.

From Theo. A. Stanley,
New Britain, Conn.

Feb. 17, 1890.

DEAR SIR:—Cultivated plants and grasses will not grow well nor yield remunerative crops when their roots are for most of the time soaked in water, and the main object of draining is to remove or lower the level of this soil water to such a point below the soil surface as will allow the plants' roots freely to ramify through the soil in search of food without coming in contact with this water. You accomplish this one object and immediately you fall heir to all the manifold advantages of a well-drained soil. These advantages may briefly be summarized as follows: Earlier working of the soil in spring, late working in fall, a warmer soil at all times, protection from drought and from over-abundant rain, changing from acid soil to a neutral one, the soil is easier worked, and more quickly worked after heavy rains, surface washing is prevented, soil fertility is retained, plants make a more healthy growth, crops are increased twofold, and the surrounding atmosphere is at all times more healthful. For the past four years I have been underdraining different fields on my farm and thus far the results are so strikingly beneficial, that not until the whole farm is thoroughly drained shall I cease doing more or less of it every year. One year ago last fall, I put in a few tile drains in a piece of land, so low that some thought it incapable of being drained; naturally the soil was rich, with a heavy clay sub-soil, yet no crops could be grown on account of the wet; before grass would do fairly well, but run out in a few years. The land was so level that there was very little fall to the drains, not over four to six inches in one hundred feet, and I really had my doubts as to the efficacy of the drains. Last summer, I planted corn on this piece of land; as all know, it was a very wet season, yet when higher adjoining fields could not be touched, owing to the wetness, this field could be worked with very little inconvenience. At the time of

harvest, the adjoining field, similar in all respects, except in not being drained, did not yield enough corn to pay for the labor, while this partially drained field yielded at the rate of one hundred and forty bushels of ear corn to the acre; had this field remained undrained, I have not the slightest doubt but that the crop would have amounted to almost nothing; hence it may be safely said that the draining more than paid for itself the first year, and I fully believe that money spent in draining, whether it be meadow land, land under cultivation, or pasture, is sure of better returns than the same amount expended in any other one farm operation.

For the successful working of my drains, I am greatly indebted to the superior quality of tile used, as manufactured by you. These tile are durably made of first class material well burned, and for the most part remarkably straight. I take pleasure in recommending them to all who may be in want of drain tile.

**From F. G. Sampson,
Boardman, Fla.**

Dec. 24, 1894.

DEAR SIR: — In answer to yours of the 18th inst. First as to the value of tile drain — there is no comparison between value of tile over open ditch — no one, I'm sure, would believe, until they saw it, that there was such a large difference in favor of tile over open ditch — in our grove we used to have water stand and evaporate within a dozen feet of four foot open ditch — now no water stands at all.

As to quality of your tile — as you know I've paid all the rail freight rates, year after year, from your works to our station here rather than use local manufacture.

Our grove allows us very slight fall to our ditches so that we have to have exact work and exact tile.

**From Henry L. Wardwell,
of McIntyre & Wardwell,**

New York Produce Exchange.

Dec. 28, 1894.

DEAR SIR: — The tile we have had from you, some three or four carloads in the past four years, have been very satisfactory, and on opening some drains, which were put in three years ago, I found them working beautifully.

I am satisfied that the improvement in the crops on the land which has been tiled will pay for the cost of same.

**From Ferris E. Davis,
Fairview Farms,**

Delhi, N. Y.

Dec. 18, 1894.

DEAR SIR: — I have derived great benefit by draining wet meadow lands, it increases its productiveness, and the hay from it is of much better quality.

When I commenced to drain, a number of years ago. I used stone, of which I had a great many, but I soon found that is was not satisfactory in all places, and the extra work of digging ditch and laying stone made it as expensive as tile. I now use tile entirely, replacing some of my old stone drains with it. Tile is so far very satisfactory. I have always bought of you, and your tile is good, which is very essential to success, and your mode of dealing with me has been upright and honest.

From D. F. Merritt,

Pres. of The Philipsburgh Coal and Land Co.,

Philipsburgh, Centre Co., Pa. NEW YORK, Dec. 18, 1890.

DEAR SIR:—The tiles shipped to me in 1887 and in 1890 were of excellent quality, and proved very satisfactory in actual use. With them I made dry cellars where we had been troubled with water and disposed of the waste and overflow from the cesspool, by carrying a system of pipes about one foot below the surface of the ground.

From H. J. Richmond, Manager

for A. G. Weeks, Guilford Springs Farm,

Guilford, Vt.

Dec. 29, 1890.

DEAR SIR:—In answer to yours of December 13th, I hope I am not too late to be of benefit to you, as I neglected to answer before through carelessness. I think tile drainage the best kind in my experience, the land cutting double the quantity of hay and much better quality than before drainage.

I find your tile of excellent quality. Have already used one carload and expect to use more.

From E. L. Ripley,

of Rhodes, Ripley & Co.,

Boston, Mass.

Dec. 24, 1890.

DEAR SIR:—The drain tile I purchased of you last year for the purpose of draining the lower portion of my mowing field at Hingham was very satisfactory indeed, both as to the results accomplished for the field, and also the pipe itself. It has enabled me to do away with a large number of ditches, and if the work is properly done I regard it as the best means of draining too wet lands for the raising of good English hay yet discovered.

From L. W. Ledyard,

Washington, D. C., and Cazenovia, N. Y.

Dec. 23, 1894.

DEAR SIR:—My experience with the various tile I have had from you for Fernwood Farm, a farm Guernsey breeders may remember, has been so fully favorable that I have for twenty years sent to you, one hundred and fifty miles from Cazenovia, while many tile are made much nearer. But they are not as accurately prepared, or have the metallic sound that yours possess. Ordinary field tile yield to wet and frost and do not repay laying. It is very false economy to put tile three or four feet under ground and then have the whole line fail from one faulty tile. Yours deserve confidence.

From Charles B. Barnes,

of Barnes, Hutchinson & Pierce,

Boston, Mass.

Feb. 17, 1890.

DEAR SIR:—I am glad to hear that you are about to publish another pamphlet on drainage, etc. It is a subject that I think the generality of farmers and owners of real estate know very little about, and I am satisfied that there are many hundreds of thousands of acres in this part of the state lying idle and useless, that with your system of tile draining could be made the very best of land and with comparatively small expense.

The meadow that Mr. Hagan drained for me with your tile has proved a perfect success and I should be pleased to show it to anyone. I do not

know of a better example of the possibility of what your system can accomplish than this, as the meadow was very soft with a crust to it only in some parts, so that a horse could not go on to it and scarcely a man even, and underneath it was mostly soft, salt mud, with, of course, fresh mud combined. I believe that it is only now four years since it was done, and I can show one of the best pieces of land in the country. It is as hard as any upland and I get two crops of the best of hay every season, and in such a one as last year, three. I can freely say that it is a revelation to me. I have a large tract of similar land that I intend to drain as soon as the town stops flowing it with salt water. This, of course, you remember, is in the town of Hingham.

From Perry R. King,
of H. B. Hollins & Co.,
New York.

Jan. 14, 1891.

DEAR SIR:—I have your letter of 18th ult., and as I have just returned from Mexico, could not answer before. I hardly know what to say, save that by means of your tile I have redeemed much waste swamp land, and during the past wet season have raised excellent crops of potatoes, where my neighbors have lost theirs raised on high, dry sand. We have always found your tile of excellent quality, and they are to-day doing their work as satisfactorily as they did three years ago when put down.

From S. S. Schultz, M. D.,
Supt. State Hospital for the Insane,
Danville, Pa.

Feb. 10, 1890.

DEAR SIR:—I have great pleasure in saying that this hospital has at times, for a number of years, purchased drain tile from you for the improvement of some of its farm land and grounds, and that your manner of doing business has always been satisfactory, and the tiles purchased of a very superior character.

As to the value of under-draining, when properly done, and the character of the soil calls for it, the experience of all, and in every place, teaches the same lesson and it need not be here restated.

From William Bitzer,
Wheeling, W. Va.

Dec. 31, 1889.

DEAR SIR:—The drain tile you shipped me on the 2nd inst. arrived here on the 19th, and upon opening the car found the tile in first-class condition—but two badly broken tile and six or eight more slightly damaged. On the whole am exceedingly well pleased with the tile. I would have no fear with such tile, when properly loaded, to be shipped across the continent and arrive in good order.

From Charles Parsons,
Conway, Mass.

Aug. 5, 1889.

DEAR SIR:—Three years ago last spring I commenced laying drain tile on my farm. At that time most, if not all, of the farmers in this town thought I was a very foolish man, as I should never see my money back. and they would do no good, etc. But now they begin to change their minds, or at least some do, and want to know the cost and where I bought them. I have always told them of you. Now, I would like the agency

for the sale of your tile in this town. I have sold quite an amount of Akron Sewer Pipe years past, and I see by the Country Gentleman that you are selling them. Will you please quote discount.

The five acres of land I drained three years ago last spring, the last week in June I cut twenty (20) tons of first quality hay, and I shall cut from ten (10) to fifteen (15) tons second crop; and it never cut ten tons in any year before it was drained and much of that poor quality; and I think it paid.

If it stops raining long enough, I expect to lay quite an amount of tile this fall, as I have six acres of fine land, which has never been ploughed, as it is too wet, I intend to plow next season. Land I drained last spring of the same character, I have good crops growing on, notwithstanding the wet season.

Please let me hear from you and oblige.

From H. M. Whitney,
Pres. West End Street Railway Company,
Boston, Mass.

Feb. 25, 1890.

DEAR SIR:—I have used a large number of your tiles in draining a meadow on my farm at Cohasset, and I am exceedingly well pleased with everything connected with the work.

Before draining the land, it was impossible to drive a team over it, whereas now, we can drive all over it; and we get about three tons of hay to the acre on land where it was impossible before to raise anything but marsh grass.

You are at liberty to make such use of this letter as you choose.

From H. E. Allison, M. D.,
Medical Supt., Matteawan State Hospital,
Fishkill Landing, N. Y.

Jan. 7, 1895.

DEAR SIR:—Your letter of the 19th ultimo received. We have used several carloads of agricultural tiles from the New York State Drain Tile & Pipe Works, and have found them well burned, of good color and satisfactory. That portion of our farming lands which we have underdrained has already been much improved and entirely changed in character, and we expect will continue to further improve from year to year.

In view of the results, we consider the work done in this direction has been a profitable investment.

From William D. Curtis,
Curtis Hotel,
Lenox, Mass.

Jan. 14, 1891.

DEAR SIR:—It gives me pleasure to say a good word for your well-known drain tile. We have given them a decided preference on our own farm, and from all the miles of different sizes and patterns sold by me to gentlemen owning large estates in Lenox, I have never had a complaint as to quality or count.

Wishing you continued success.

From Wm. H. Lawton, Jr.,
 Mem. Am. So. C. E., Civil Engineer,
 Newport, R. I.

Dec. 16, 1890.

DEAR SIR:—I have used in my business here, during the last six years, many thousand feet of your drain pipe and have always recommended it to others. I have always found your pipe true in form, straight, strong and tough in texture.

In the neighboring town of Middletown, I have laid in their highways to a great benefit, your pipe in the following manner: In the centre of the road, which, like most country roads, is almost impassable in winter and early spring, a trench was dug about four feet deep, and carefully graded, then hemlock strips were laid on the bottom, and on top of these, your 4 in. concrete drain pipe; the trench was then filled to the surface of the road with stone, carefully packed by hand. The result is a permanent improvement in the condition of the roads, they being much dryer and harder.

From G. A. Parker,
 Supt. of Keney Park,
 Hartford, Conn.

Dec. 3, 1901.

DEAR SIR:—If all the drains laid with your tile on Keney Park had been one continuous drain it would have been between 48 and 49 miles in length. Mr. James Hagan was the contractor. The tile, workmanship and results are entirely satisfactory. Mr. Hagan is the best man for tile drainage I have ever met. The tile, sound and well-burnt. Result: every drain working freely.

Drainage well done is like a well-cooked dinner which the healthy man eats with pleasure without discomfort afterward, and a poor-cooked dinner does not cause a dyspeptic more trouble than poor drain work will the owner. Poor cooking spoils good food. Indigestion makes both food and cooking useless, so poor work makes worthless the best of tile. But, have given — Jackson tile, James Hagan and a swamp. Results — The owner soon forgets there ever was a swamp in the satisfaction of using as desirable a piece of land as heart could wish.

A FEW OF MANY LETTERS

received referring to work done by one of my practical drainers, Mr. James Hagan. Mr. Hagan has now worked for me continuously for over twenty (20) years, and during that time he, with his assistants, has done many large and difficult jobs of draining, invariably giving perfect satisfaction.

From H. C. Haven, M. D.,
 Stockbridge, Mass.

Oct. 24, 1901

MR. JAMES HAGAN — I cannot speak too highly of the work you have done for me and the manner in which it has been carried out. The character of the work and the good it has already accomplished have surpassed my expectations. You are skillful in design and your workmen are speedy and faithful in construction. I consider that your industry is only equaled by your honesty.

From D. I. Garth,
Searsdale, N. Y.

July 18, 1887.

TO JAMES HAGAN,—

DEAR SIR :—The job of tile draining lately done by you for me appears to have been done in the best and most careful manner, and I think will be effectual in reclaiming the land and make a fine meadow out of what has been of little value heretofore. I cheerfully recommend you to any one having ditching to do, as faithful and competent for the work.

From Harley T. Proctor,
Williamstown, Mass.

Nov. 7, 1892.

TO WHOM IT MAY CONCERN :—Unsolicited and with pleasure I heartily recommend to all who contemplate draining land, Mr. James Hagan. He lays out the work intelligently and well. His ditching and laying of the tile is thorough and workmanlike. He has just completed the laying of over three miles of drains for me to my entire satisfaction.

From Lucius Tuckerman,
New York, N. Y.

March 26, 1884.

TO JAMES HAGAN,—

DEAR SIR :—In reply to your note of yesterday, I say with pleasure that I believe the job of draining which you did for me last autumn, was very well done.

And further, while working by the day, I think you were unfailing in your industry, and accomplished the best day's work I ever saw done.

From F. Bronson,
Verna,
Greenfield Hill, Conn.

Nov. 21, 1887.

DEAR SIR :—Your man, James Hagan, has just finished laying my tile. He has been some time at work, owing to my having the tile covered with stone. I am very well satisfied with his work, which I think he did very conscientiously and well. Many thanks for sending me such a careful man.

From C. M. Pratt,
New York, N. Y.

Aug. 9, 1892.

TO JAMES HAGAN,—

DEAR SIR :—It is now nearly two years since you completed the drainage of our property at Glen Cove, L. I., thus admitting of an intelligent expression as to the success of your work. As far as I have been able to discover, the work has been almost uniformly successful. Since you were there some considerable grading and filling has been done, which doubtless has affected the drainage in one or two spots, but with those exceptions the work has been in every way successful.

From William H. Mansfield,
West Hartford, Conn.

Feb. 14, 1896.

DEAR SIR :—The tile draining done for us in the autumn of 1894 thus far proves very satisfactory. Of the fifteen acres or upwards so drained we were unable to cultivate only a portion of the area, but from that tilled satisfactory crops were secured. The balance will be brought into

cultivation this season, from which we are anticipating good results. Mr. James Hagan, from your city, who has charge of the work, we found an experienced and painstaking workman, and were we to have any more draining done, should be very anxious to secure his valuable services.

From Peter B. Bradley,
of the Bradley Fertilizer Company,
92 State Street, Boston, Mass.

Feb. 13, 1896.

TO JAMES HAGAN—

DEAR SIR:— In reply to your favor of the 11th inst., I would say that the drain tiling which you put down on my father's estate at Hingham, and also that which you did for me, is still doing good service and giving satisfaction. The thorough manner in which you did the work shows lasting and beneficial results. There has never been a time but what the drains worked perfectly. I was not sure that the drain on the hillside would prove a success; but it has been quite as beneficial in this case as the draining you did in the lowland. The amount of hay per acre has not only been greatly increased, but the quality has been much improved. It certainly pays to lay tiling in heavy cold soils. The crops show the effects of such drainage at once.

I take pleasure in recommending you as a good party to engineer and do a job of draining.

From Rev. Francis Goodwin,
291 Main St., Hartford, Conn.

Feb. 12, 1896.

DEAR SIR:—I have used your drain tile in considerable quantities and have found them to be excellent in quality and more reasonable in price than I have been able to obtain elsewhere.

All of my draining has been done by Mr. James Hagan, of Albany, and has been very satisfactorily done, with results that have exceeded my anticipations. Land too wet to be worked to advantage in the spring has been made dry enough for early crops.

From H. F. Dimock,
Agent Metropolitan Steamship Co.,

Pier 11, North River, New York, N. Y. Feb. 13, 1896.

TO JAMES HAGAN—

DEAR SIR:—I am in receipt of yours of the 11th inst., requesting me to give you some little account of the effect of the tile draining you did for me several years since. I gladly comply.

As you know, my farm is at South Coventry, Conn. Several years since I concluded to reclaim an old pasture of sixteen acres, which in addition to being very rough was wet in some places. You did the work for me. I do not know how many miles of tile drains you put in, but you made a most thorough and satisfactory job. Before I commenced on the land I do not suppose it was worth five dollars per acre; but it is now perhaps as fine a field as there is in the state of Connecticut. It is always sufficiently dry, and I consider that not only did you do the work in a most thorough and satisfactory manner, but the results of the draining has been all that I could have expected.

Hope that this statement may be of some use to you.

SALT GLAZED VITRIFIED SEWER PIPE.

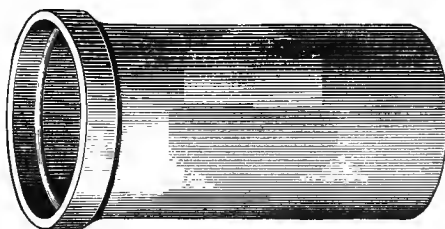
Celebrated Standard

Akron and Ohio River Salt Glazed Vitrified Sewer Pipe.

I offer these Standard and Superior Goods at the Very Lowest Rates

REMEMBER THEY NOW COST NO MORE THAN INFERIOR GOODS.

Unequalled
in
Quality.



Prices
Very
Low.

Price List of "Standard" Vitrified Sewer Pipe adopted December 19, 1901 :

2 in. Pipe, per foot.....	\$0.16	12 in. Pipe, per foot.....	\$1.00
Bends, Elbows, each.....	.50	Bends, Elbows, each.....	4.00
Branches, each.....	.72	Branches, each.....	4.50
7 lbs. Traps, each.....	1.50	45 lbs. Traps, each.....	15.00
3 in. Pipe, per foot.....	\$0.16	15 in. Pipe, per foot.....	\$1.35
Bends, Elbows, each.....	.50	Bends, Elbows, each.....	5.40
Branches, each.....	.72	Branches, each.....	6.10
8 lbs. Traps, each.....	1.50	67 lbs. Traps, each.....	22.00
4 in. Pipe, per foot.....	\$0.20	18 in. Pipe, per foot.....	\$1.70
Bends, Elbows, each.....	.65	Bends, Elbows, each.....	6.80
Branches, each.....	.90	Branches, each.....	7.65
10 lbs. Traps, each.....	2.00	84 lbs. Traps, each.....	
5 in. Pipe, per foot.....	\$0.25	20 in. Pipe, per foot.....	\$2.25
Bends, Elbows, each.....	.85	Bends, Elbows, each.....	9.00
Branches, each.....	1.13	Branches, each.....	10.13
12 lbs. Traps, each.....	2.50	100 lbs. Traps, each.....	
6 in. Pipe, per foot.....	\$0.30	24 in. Pipe, per foot.....	\$3.25
Bends, Elbows, each.....	1.10	Bends, Elbows, each.....	13.00
Branches, each.....	1.35	Branches, each.....	14.63
16 lbs. Traps, each.....	3.50	140 lbs. Traps, each.....	
8 in. Pipe, per foot.....	\$0.50	27 in. Pipe, per foot.....	\$4.25
Bends, Elbows, each.....	2.00	Bends, Elbows, each.....	20.00
Branches, each.....	2.25	Branches, 2 1/4 feet.....	21.25
24 lbs. Traps, each.....	6.60	221 lbs. Traps, each.....	
10 in. Pipe, per foot.....	\$0.75	30 in. Pipe, per foot.....	\$5.50
Bends, Elbows, each.....	3.00	Bends, Elbows, each.....	27.50
Branches, each.....	3.40	Branches, 2 1/2 feet.....	27.50
34 lbs. Traps, each.....	9.00	252 lbs. Traps, each.....	

The weights are of plain pipe per foot. Branches are always two feet long unless other length is specified. Pipe of all sizes may be furnished with Sockets or Rings, and Ring pipe may be sold at a discount of ten per cent. from bill. Increasers shall have Socket on small end, Reducers, Socket on large end, and shall be charged at double the price of two feet of pipe, size of large end. Each piece of Channel or Split pipe shall be charged as three-fifths of a whole pipe. Stoppers or Plugs for closing pipe, one-third of one foot of pipe of the size in which it is used. Fifty per cent. additional for Inlets 15 inch or larger on any size pipe. Branches three feet in length add price of two feet of pipe to price of two feet branch. Each Inlet in addition to Single Branch shall be charged for at price that is added to straight pipe for first Inlet.

I carry immense stock of all sizes of Pipe and Elbow, Y and T branches for same, which enables me to fill all orders without delay.

The above are list prices, and are subject to large reductions or discount, even on small orders. Special prices on orders for carload or more. Send for discount.

Price List of Drain Tile and Collars.



13 INCHES LONG.

The sizes named are inside measurement.

					Lbs.
2	inch.....	\$15.00	per 1,000	pieces.....	weight 3,000
2½	"	20.00	"	"	" 4,000
3	"	25.00	"	"	" 5,000
4	"	45.00	"	"	" 7,000
5	"	75.00	"	"	" 9,500
6	"	100.00	"	"	" 11,000
8	"	150.00	"	"	" 17,000
10	"	250.00	"	"	" 25,000
12	"	350.00	"	"	" 35,000

HEXAGON TILE.



13 INCHES LONG.

					Lbs.
2	inch.....	\$15.00	per 1,000	pieces.....	weight 3,000
3	"	25.00	"	"	" 5,000
4	"	45.00	"	"	" 8,000
5	"	75.00	"	"	" 10,000
6	"	100.00	"	"	" 13,500

COLLARS FOR ROUND TILE.



					Lbs.
For 2	inch Tile...	\$10.00	per 1,000	pieces....	weight 1,000
2½	"	12.00	"	"	" 1,250
3	"	15.00	"	"	" 1,500
4	"	20.00	"	"	" 2,000
5	"	30.00	"	"	" 3,500
6	"	40.00	"	"	" 4,000
8	"	65.00	"	"	" 6,000

The above and opposite page are list prices, and are subject to large discounts, even on small orders. Special price on large orders.

Price List of Round and Hexagon Elbows, Y and T Branches.



Round and Hexagon same Price.

2 x 2 in. 12c each

$2\frac{1}{2}$ x 2 in. }
 $2\frac{1}{2}$ x $2\frac{1}{2}$ in. } 15c each

3 x 2 in. }
 3 x $2\frac{1}{2}$ in. } 20c each.
 3 x 3 in. }

4 x 2 in. }
 4 x $2\frac{1}{2}$ in. } 25c each.
 4 x 3 in. }
 4 x 4 in. }

10 in., 55c.

5 x 2 in. }
 5 x $2\frac{1}{2}$ in. } 30c each.
 5 x 3 in. }
 5 x 4 in. }
 5 x 5 in. }

6 x 2 in. }
 6 x $2\frac{1}{2}$ in. } 35c each.
 6 x 3 in. }
 6 x 4 in. }
 6 x 5 in. }
 6 x 6 in. }

8 x 2 in. }
 8 x $2\frac{1}{2}$ in. } 45c each.
 8 x 3 in. }
 8 x 4 in. }
 8 x 5 in. }
 8 x 6 in. }
 8 x 8 in. }

12 in., 65c.

I would respectfully ask the attention of my customers to the above branches and prices of same; although only used in connection with Drain Tile during the past few years, they have long been greatly needed. They not only make the connecting of drains a very easy matter, and the work when completed simply perfect, but they save much time, trouble and expense. They at once became very popular and the demand is increasing very rapidly.

I advise those who have connections to make to order branches when ordering their tile.

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Benefits of drainage and how to drain. .



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